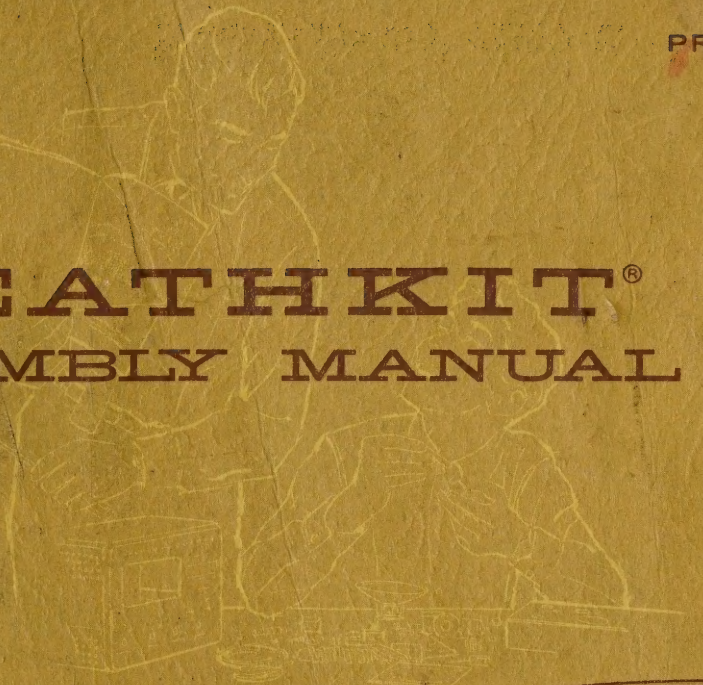
PRICE $1.00

HEATH COMPANY
BENTON HARBOR, MICHIGAN

HEATHKIT®
ASSEMBLY MANUAL



HEATHKIT

DECADE RESISTANCE KIT

MODEL IN-11

RESISTOR COLOR CODES

The colored bands around the body of a color coded resistor represent its value in ohms. These colored bands are grouped toward one end of the resistor body. Starting with this end of the resistor, the first band represents the first digit of the resistance value; the second band represents the second digit; the third band represents the number by which the first two digits are multiplied. A fourth band of gold or silver represents a tolerance of ±5% or ±10% respectively. The absence of a fourth band indicates a tolerance of ±20%.

The physical size of a composition resistor is related to its wattage rating. Size increases progressively as the wattage rating is increased. The diameters of 1/2 watt, 1 watt and 2 watt resistors are approximately 1/8", 1/4" and 5/16", respectively.

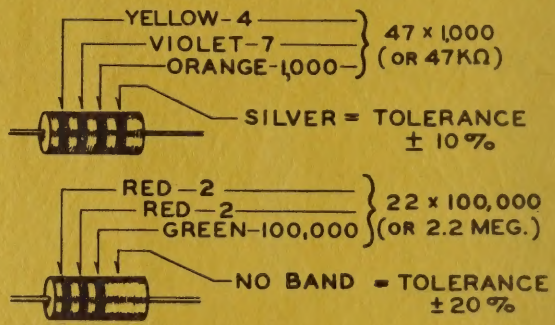
The color code chart and examples which follow provide the information required to identify color coded resistors.

CODE

COLOR	1ST DIGIT	2ND DIGIT	MULTIPLIER
BLACK	0	0	1
BROWN	1	1	10
RED	2	2	100
ORANGE	3	3	1,000
YELLOW	4	4	10,000
GREEN	5	5	100,000
BLUE	6	6	1,000,000
VIOLET	7	7	10,000,000
GRAY	8	8	100,000,000
WHITE	9	9	1,000,000,000
GOLD	-	-	.1
SILVER	-	-	.01

TOLERANCE
GOLD ±5%
SILVER ±10%
NO BAND ±20%

EXAMPLES



USING A PLASTIC NUT STARTER

A plastic nut starter offers a convenient method of starting the most used sizes: 3/16" and 1/4" (3-48 and 6-32). When the correct end is pushed down over a nut, the pliable tool conforms to the shape of the nut and the nut is gently held while it is being picked up and started on the screw. The tool should only be used to start the nut.

Assembly

and

Operation

of the

HEATHKIT®

DECADE RESISTANCE KIT

MODEL IN-11

TABLE OF CONTENTS

Specifications. 2
Introduction. 2
Circuit Description. 3
Parts List. 3
Schematic. 3*
Construction Notes. 4
Step-By-Step Assembly. 5
Initial Operation Check. 8
Operation. 8
In Case Of Difficulty. 9
Service Information. 9
Warranty. 12

*Fold-out from page.

All prices are subject to change without notice. The Heath Company reserves the right to discontinue instruments and to change specifications at any time without incurring any obligations to incorporate new features in instruments previously sold.

HEATHKIT

Copyright © 1961
Heath Company
All rights reserved

7/10/64

SPECIFICATIONS

Range	1 Ω to 999,999 Ω in 1 Ω steps.
Resistors	Precision, 1/2% accuracy, 1 watt.
Maximum Current For Each Range	

	WORKING RATING	MAXIMUM RATING
X1 -	500 ma.	1000 ma.
X10 -	150 ma.	300 ma.
X100-	50 ma.	100 ma.
X1K-	15 ma.	30 ma.
X10K-	5 ma.	10 ma.
X100K-	1.5 ma.	3 ma.

Minimum DC Resistance	.043 Ω at terminals with all switches set at zero.
Dimensions	7-1/2" wide x 5" high x 6-5/8" deep.
Net Weight	2-1/2 lbs.

INTRODUCTION

The IN-11 Decade Resistance Kit was designed as an accurate laboratory-type instrument for use wherever electrical measurements involving resistors are made. The wide range of available resistance values makes the IN-11 invaluable as a variable multiplier or shunt, a variable substitution resistor, or as an arm for DC and AC bridges. The HEATHKIT Decade Capacitance Kit makes an ideal companion with the IN-11 for solving resistance and capacitance networks where a large range of values are necessary.

CIRCUIT DESCRIPTION

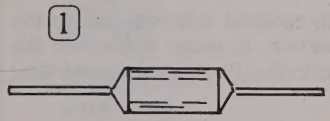
The series arrangement of the range switches and the precision resistors as shown on the Schematic Diagram will yield any resistance value from 1 to 999,999 Ω in 1 Ω steps. Each resistor is rated to be within 1/2% of its ohmic value for precision applications. The 0 position of the range switches allows the resistors to be bypassed if desired. The multiplier printed beneath each range switch on the front panel indicates the value of each resistor for that particular switch. The "shorting-type" switches with make-before-break action permit smooth adjustment of the resistance value without opening or shorting of the circuit.

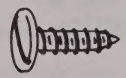
PARTS LIST

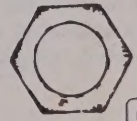
Unpack the kit carefully and check each part against the Parts List. The numbers in front of the Part Number correspond to the picture of that part for quick and positive identification.

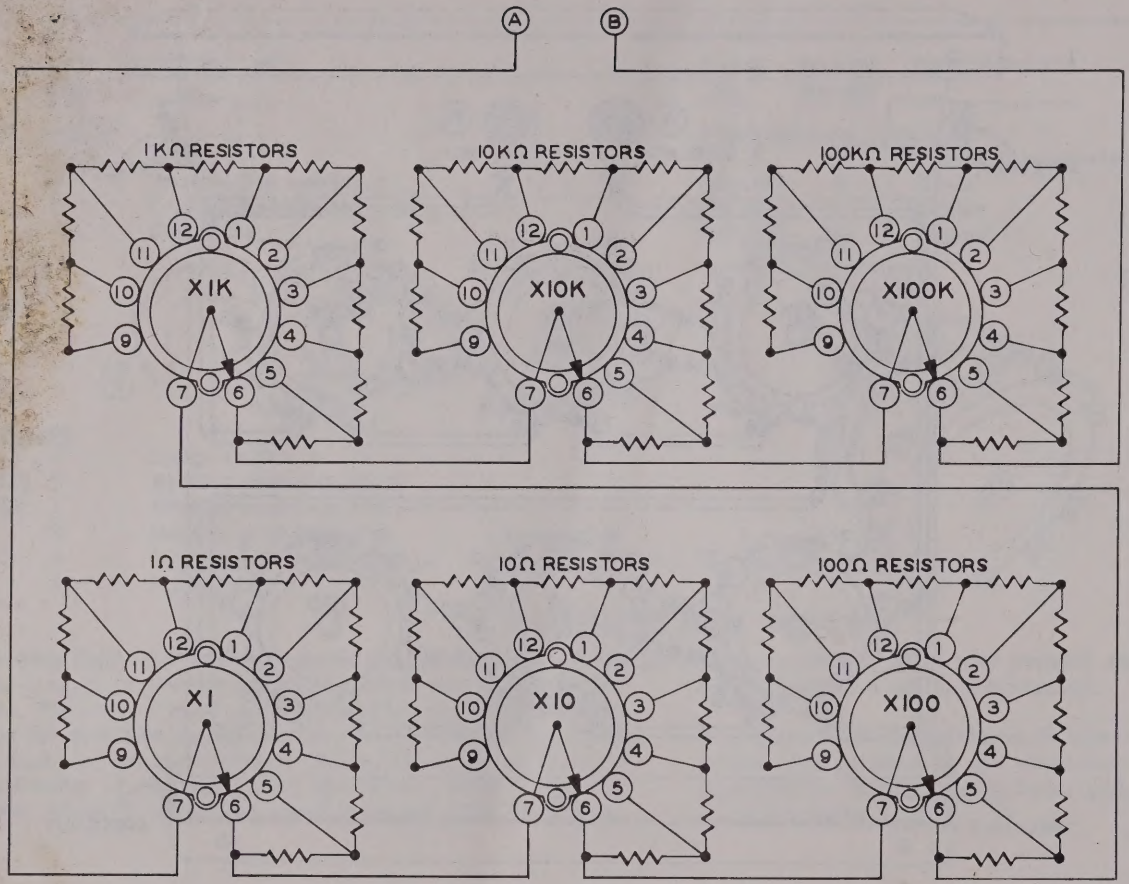
PART No.	PARTS Per Kit	DESCRIPTION
Resistors (Precision 1/2% 1 watt)		
① 2A-46	9	1 Ω
2A-47	9	10 Ω
② 2A-48	9	100 Ω
2A-49	9	1 KΩ
2A-50	9	10 KΩ
2A-51	9	100 KΩ

PART No.	PARTS Per Kit	DESCRIPTION
Sheet Metal Parts		
90-M204F	1	Cabinet shell
100-M367F656-657-658	1	Front panel
Hardware		
③ 250-8	4	#6 sheet metal screw
④ 250-89	4	6-32 screw
⑤ 252-3	2	6-32 nut
⑥ 252-7	6	Control nut









SCHEMATIC DIAGRAM
MODEL IN-11

The abbreviation "NS" indicates that a connection should not be soldered yet as other wires will be added. When the last wire is installed, the terminal should be soldered and the abbreviation "S" is used to indicate this. Note that a number will appear after each solder instruction. This number indicates the number of leads that are supposed to be connected to the terminal in point before it is soldered. For example, if the instruction reads, "Connect a lead to lug 1 (S-2)," it will be understood that there will be two leads connected to the terminal at the time it is soldered.

Position the work, if possible, so that gravity will help to keep the solder where you want it. The joint to be soldered should be heated with the flat side of the soldering iron tip sufficiently to melt the solder. Apply only enough solder to the heated terminal to thoroughly wet the junction. Remove the solder and then the iron when a smooth soldered junction appears. Do not move the leads until the solder is solidified.

ROSIN CORE SOLDER HAS BEEN SUPPLIED WITH THIS KIT. THIS TYPE OF SOLDER MUST BE USED FOR ALL SOLDERING IN THIS KIT. ALL GUARANTEES ARE VOIDED AND WE WILL NOT REPAIR OR SERVICE EQUIPMENT IN WHICH ACID CORE SOLDER OR PASTE FLUXES HAVE BEEN USED. IF ADDITIONAL SOLDER IS NEEDED, BE SURE TO PURCHASE ROSIN CORE (60:40 or 50:50 TIN-LEAD CONTENT) RADIO TYPE SOLDER.

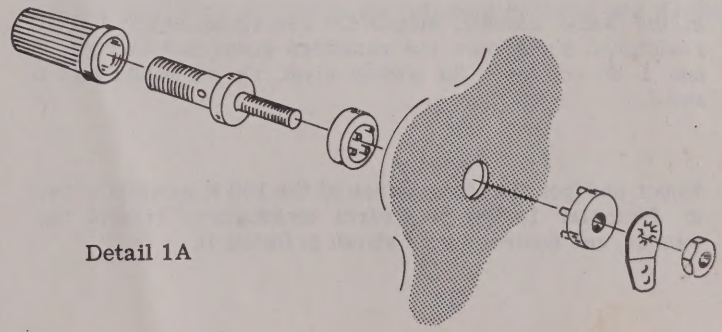
STEP-BY-STEP ASSEMBLY

Refer to Pictorial 1 (fold-out from Page 4) for the following steps.

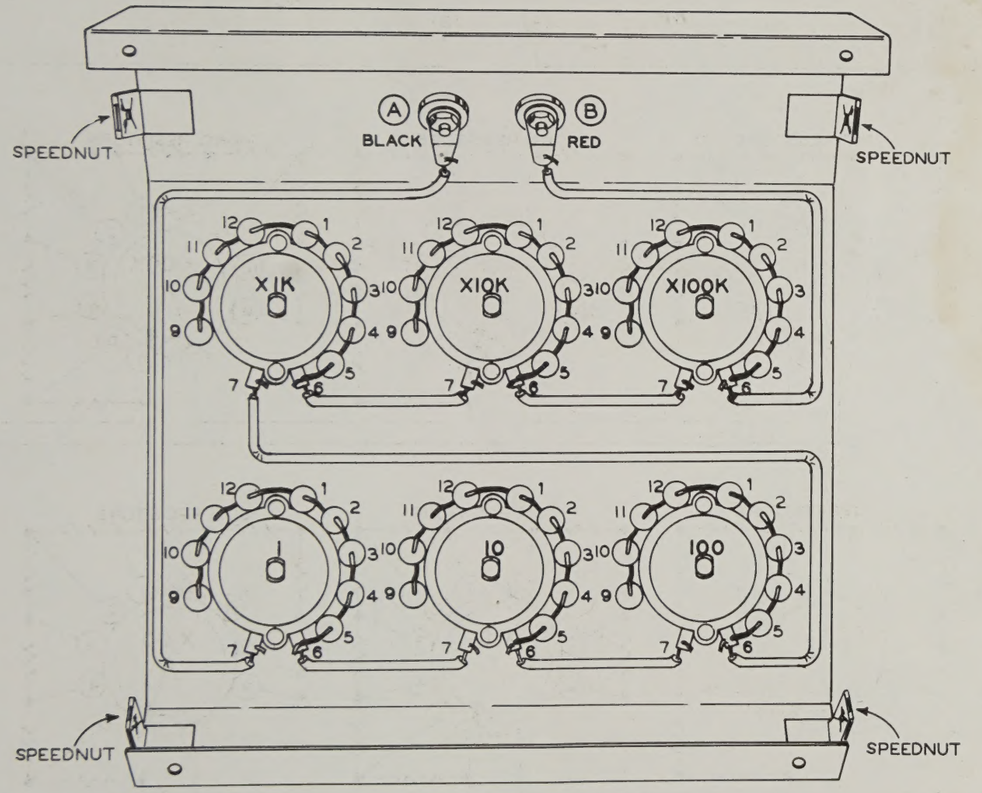
( ) Mount binding posts at A and B with black and red caps, respectively. Note solder lug positioning. See Detail 1A for assembly, using the binding post insulators.

( ) Locate all nine 100 KΩ resistors so that they will be readily available. (Make sure that all nine of the resistors are 100 KΩ).

( ) Position one of the range switches so that a rear view of the switch will correspond to that shown in Detail 1B.



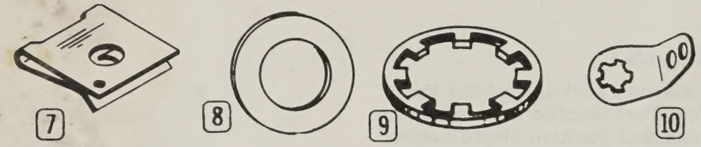
Detail 1A



Pictorial 1

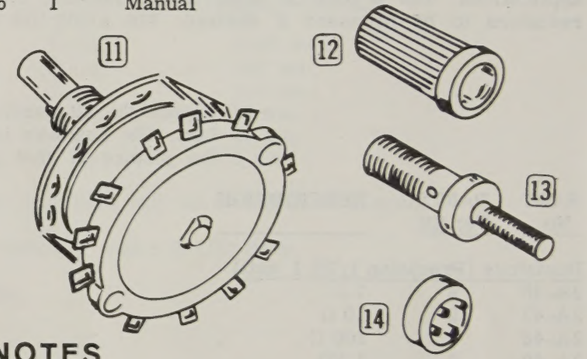
HEATHKIT

PART No.	PARTS Per Kit	DESCRIPTION
Hardware (cont'd.)		
[7] 252-22	4	Speednut
[8] 253-10	6	Control flat washer
[9] 254-4	6	Control lockwasher
[10] 259-1	2	Solder lug



Miscellaneous		
[11] 63-291	6	Range switch
[12] 100-M16B	1	Binding post cap, black
100-M16R	1	Binding post cap, red
[13] 427-2	2	Binding post base
[14] 75-17	4	Binding post insulator
261-4	4	Rubber feet

PART No.	PARTS Per Kit	DESCRIPTION
Miscellaneous (cont'd.)		
344-6	1	Length hookup wire
462-187	6	Knob
331-6		Solder
595-506	1	Manual



CONSTRUCTION NOTES

The following instructions are presented in a logical step-by-step sequence to enable you to complete your kit with the least possible confusion. Be sure to read each step all the way through before beginning the specified operation. Also read several steps ahead of the actual step being performed. This will familiarize you with the relationship of the subsequent operations. When the step is completed, check it off in the space provided. This is particularly important as it may prevent errors or omissions, especially if your work is interrupted.

In general, the illustrations in this manual correspond to the actual configuration of the kit; however, in some instances the illustrations may be slightly distorted to facilitate clearly showing all of the parts.

The abbreviation "NS" indicates that a connection should not be soldered yet as other wires will be added. When the last wire is installed, the terminal should be soldered and the abbreviation "S" is used to indicate this. Note that a number will appear after each solder instruction. This number indicates the number of leads that are supposed to be connected to the terminal in point before it is soldered. For example, if the instruction reads, "Connect a lead to lug 1 (S-2)," it will be understood that there will be two leads connected to the terminal at the time it is soldered.

Position the work, if possible, so that gravity will help to keep the solder where you want it. The joint to be soldered should be heated with the flat side of the soldering iron tip sufficiently to melt the solder. Apply only enough solder to the heated terminal to thoroughly wet the junction. Remove the solder and then the iron when a smooth soldered junction appears. Do not move the leads until the solder is solidified.

ROSIN CORE SOLDER HAS BEEN SUPPLIED WITH THIS KIT. THIS TYPE OF SOLDER MUST BE USED FOR ALL SOLDERING IN THIS KIT. ALL GUARANTEES ARE VOIDED AND WE WILL NOT REPAIR OR SERVICE EQUIPMENT IN WHICH ACID CORE SOLDER OR PASTE FLUXES HAVE BEEN USED. IF ADDITIONAL SOLDER IS NEEDED, BE SURE TO PURCHASE ROSIN CORE (60:40 or 50:50 TIN-LEAD CONTENT) RADIO TYPE SOLDER.

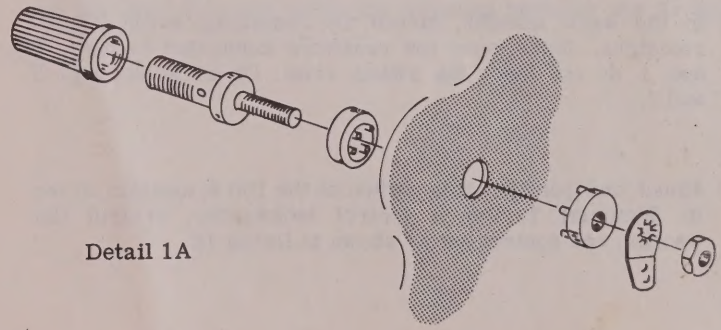
STEP-BY-STEP ASSEMBLY

Refer to Pictorial 1 (fold-out from Page 4) for the following steps.

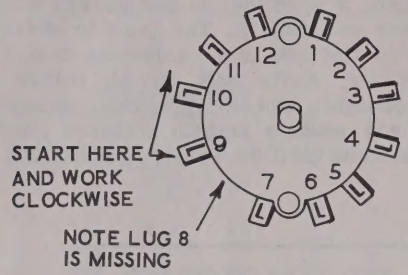
( ) Mount binding posts at A and B with black and red caps, respectively. Note solder lug positioning. See Detail 1A for assembly, using the binding post insulators.

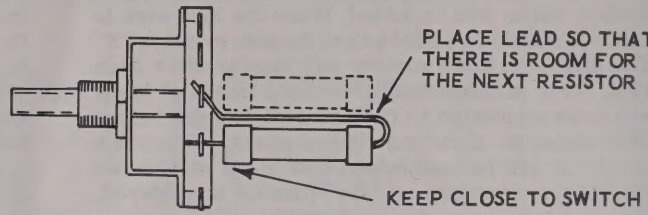
( ) Locate all nine 100 KΩ resistors so that they will be readily available. (Make sure that all nine of the resistors are 100 KΩ).

( ) Position one of the range switches so that a rear view of the switch will correspond to that shown in Detail 1B.



Detail 1A





Detail 1B

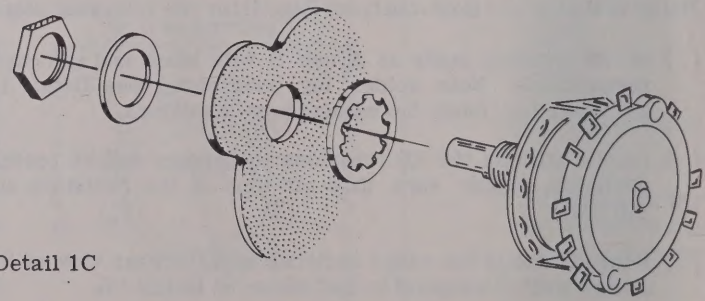
( ) Position one of the 100 KΩ resistors and its leads as suggested in Detail 1B and connect it between lugs 9 (S-1) and 10 (NS).

( ) Install another 100 KΩ resistor between lugs 10 (S-2) and 11 (NS).

( ) In the same manner, install the remaining seven 100 KΩ resistors. Make sure the resistors connected to lugs 12 and 1 do not touch the switch rivet. Do not solder lugs 6 and 7.

( ) Mount and position this switch at the 100 K location shown in Pictorial 1. Use a control lockwasher, control flat washer, and control nut as shown in Detail 1C.

( ) Install the knobs on the switch shafts as each is wired and mounted to the front panel. Tighten the setscrew to the flat side of the shaft and make sure each knob pointer is in line with the numbers on the front panel.



Detail 1C

( ) Wire and mount the 10K, 1K, 100, 10 and 1 range switches in the same manner as outlined for the 100K switch (do not forget the knobs). See Pictorial 1 for the proper switch position and location.

Strip 1/4" of insulation from each end of the hookup wire to be connected between the following lugs. See Pictorial 1 for proper wire positioning.

	FROM LUG	TO LUG
( )	6 of switch 100 K (S-2)	Solder lug of binding post B (S-1).
( )	7 of switch 100 K (S-1)	6 of switch 10 K (S-2).
( )	7 of switch 10 K (S-1)	6 of switch 1 K (S-2).
( )	7 of switch 1 K (S-1)	6 of switch 100 (S-2).
( )	7 of switch 100 (S-1)	6 of switch 10 (S-2).
( )	7 of switch 10 (S-1)	6 of switch 1 (S-2).
( )	7 of switch 1 (S-1)	Solder lug of binding post A (S-1).

This completes the wiring. Check all the resistors and other wiring for proper solder connections. Make sure each resistor and its lead does not touch the adjacent resistor and its lead.

For a thorough operation check, refer to the Initial Operation Check section of the manual. Use this method of checking if your facilities allow, otherwise refer to the last three steps under Initial Operation Check.

INITIAL OPERATION CHECK

If an ohmmeter is handy, the range switch contacts and the wiring may be checked for proper operation. Connect the ohmmeter leads to the red and black binding posts of the IN-11. Set all the range switches in the 0 position. The ohmmeter should read 0. Keep in mind that the measured resistances will vary, depending on the accuracy of your ohmmeter. Now advance the X1 range switch. With the ohmmeter set properly, it should increase by 1 Ω increments. Advance and check the X10 range switch for 10 Ω increments. All of the switches should be checked in this manner. If a short circuit, open circuit, or improper incremental resistance increase is detected as the switches are rotated, it can be remedied very quickly by checking the associated switch circuitry. If necessary, refer to the In Case Of Difficulty section. If operation is as described, you may assume that it is properly constructed.

( ) Place a speednut on each of the small L brackets located on each side of the front panel. The flat side of each speednut should face toward the outside of the panel.

( ) Install the four rubber feet on the bottom of the cabinet shell. The four large holes are for this purpose.

( ) Mount the cabinet shell to the front panel, using 6-32 screws on the L brackets and four #6 sheet metal screws on the bottom of the front panel.

OPERATION

The Decade Resistance Kit is very simple to operate. Just connect it to the circuit under test and adjust the range switches for the particular resistance needed. The total value of resistance is determined by adding the settings of the six range switches. For example; if the range switches were set as follows: The X1 switch at 5, the X10 switch at 7, the X100 switch at 0, the 1K switch at 9, the X10K switch at 1, and the X100K switch at 4, the total resistance presented at the binding posts would be 419,075 Ω or 419.075 KΩ.

CAUTION: Observe the current limitations as outlined in the Specifications. This means the highest range switch in use (off of 0 position) will determine the maximum allowable current.

IN CASE OF DIFFICULTY

1. Recheck the wiring. Trace each lead in colored pencil on the Pictorial as it is checked. It is frequently helpful to have a friend check your work. Someone who is not familiar with the unit may notice something consistently overlooked by the constructor.

2. It is interesting to note that about 90% of the kits that are returned for repair do not function properly due to poor connections and soldering. Therefore, many troubles can be eliminated by reheating all connections to make sure that they are soldered properly.

3. Check the values of the component parts. Be sure that the proper part has been wired into the circuit, as shown in the pictorial diagrams and as called out in the wiring instructions.

4. Check for bits of solder, wire ends or other foreign matter which may be lodged in the wiring beneath the panel.

5. Repeating the Initial Operation Check procedure may be helpful in pinpointing the problem.

SERVICE INFORMATION

SERVICE

If, after applying the information contained in this manual and your best efforts, you are still unable to obtain proper performance, it is suggested that you take advantage of the technical facilities which the Heath Company makes available to its customers.

The Technical Consultation Department is maintained for your benefit. This service is available to you at no charge. Its primary purpose is to provide assistance for those who encounter difficulty in the construction, operation or maintenance of HEATHKIT equipment. It is not intended, and is not equipped to function as a general source of technical information involving kit modifications nor anything other than the normal and specified performance of HEATHKIT equipment.

Although the Technical Consultants are familiar with all details of this kit, the effectiveness of their advice will depend entirely upon the amount and the accuracy of the information furnished by you. In a sense, YOU MUST QUALIFY for GOOD technical advice by helping the consultants to help you. Please use this outline:

1. Before writing, fully investigate each of the hints and suggestions listed in this manual under In Case Of Difficulty. Possibly it will not be necessary to write.

2. When writing, clearly describe the nature of the trouble and mention all associated equipment. Specifically report operating procedures, switch positions, connections to other units and anything else that might help to isolate the cause of trouble.

3. Report fully on the results obtained when testing the unit initially and when following the suggestions under In Case Of Difficulty. Be as specific as possible.

4. Identify the kit model number and date of purchase, if available. Also mention the date of the kit assembly manual. (Date at bottom of Page 1.)

5. Print or type your name and address, preferably in two places on the letter.

With the preceding information, the consultant will know exactly what kit you have, what you would like it to do for you and the difficulty you wish to correct. The date of purchase tells him whether or not engineering changes have been made since it was shipped to you. He will know what you have done in an effort to locate the cause of trouble and, thereby, avoid repetitious suggestions. In short, he will devote full time to the problem at hand, and through his familiarity with the kit, plus your accurate report, he will be able to give you a complete and helpful answer. If replacement parts are required, they will be shipped to you, subject to the terms of the Warranty.

The Factory Service Facilities are also available to you in the event that you prefer to have the difficulty corrected in this manner. You may return the completed kit to the Heath Company for inspection and necessary repairs. You will be charged a minimal fee, plus the price of any parts or material required. However, if the completed kit is returned within the Warranty period, parts charges will be governed by the terms of the Warranty. State the date of purchase, if possible.

Local Service by Authorized HEATHKIT Service Centers is also available in some areas and often will be your fastest, most efficient method of obtaining service for your HEATHKIT equipment. Although you may find charges for local service somewhat higher than for factory service, the amount of increase is usually offset by the transportation charge you would pay if you elected to return your kit to the Heath Company.

HEATHKIT Service Centers will honor the regular 90 day HEATHKIT Parts Warranty on all kits, whether purchased through a dealer or directly from Heath Company; however, it will be necessary that you verify the purchase date of your kit.

Under the conditions specified in the Warranty, replacement parts are supplied without charge; however, if the Service Center assists you in locating a defective part (or parts) in your kit, or installs a replacement part for you, you may be charged for this service.

HEATHKIT equipment purchased locally and returned to Heath Company for service must be accompanied by your copy of the dated sales receipt from your authorized HEATHKIT dealer in order to be eligible for parts replacement under the terms of the Warranty.

THIS SERVICE POLICY APPLIES ONLY TO COMPLETED EQUIPMENT CONSTRUCTED IN ACCORDANCE WITH THE INSTRUCTIONS AS STATED IN THE MANUAL. Equipment that has been modified in design will not be accepted for repair. If there is evidence of acid core solder or paste fluxes, the equipment will be returned NOT repaired.

For information regarding modification of HEATHKIT equipment for special applications, it is suggested that you refer to any one or more of the many publications that are available on all phases of electronics. They can be obtained at or through your local library, as well as at most electronic equipment stores. Although the Heath Company sincerely welcomes all comments and suggestions, it would be impossible to design, test, evaluate and assume responsibility for proposed circuit changes for special purposes. Therefore, such modifications must be made at the discretion of the kit builder, using information available from sources other than the Heath Company.

REPLACEMENTS

Material supplied with HEATHKIT products has been carefully selected to meet design requirements and ordinarily will fulfill its function without difficulty. Occasionally improper instrument operation can be traced to a faulty component. Should inspection reveal the necessity for replacement, write to the Heath Company and supply all of the following information.

A. Thoroughly identify the part in question by using the part number and description found in the Manual Parts List.

B. Identify the type and model number of kit in which it is used.

C. Mention date of purchase.

D. Describe the nature of defect or reason for requesting replacement.

The Heath Company will promptly supply the necessary replacement. PLEASE DO NOT RETURN THE ORIGINAL COMPONENT UNTIL SPECIFICALLY REQUESTED TO DO SO. Do not dismantle the component in question as this will void the guarantee. This replacement policy does not cover the free replacement of parts that may have been broken or damaged through carelessness on the part of the kit builder.

SHIPPING INSTRUCTIONS

In the event that your equipment must be returned for service, these instructions should be carefully followed.

ATTACH A TAG TO THE EQUIPMENT BEARING YOUR NAME, COMPLETE ADDRESS, DATE OF PURCHASE, AND A BRIEF DESCRIPTION OF THE DIFFICULTY ENCOUNTERED. Wrap the equipment in heavy paper, exercising care to prevent damage.

Place the wrapped equipment in a stout carton of such size that at least three inches of shredded paper, excelsior, or other resilient packing material can be placed between all sides of the wrapped equipment and the carton. Close and seal the carton with gummed paper tape, or alternately, tie securely with stout cord. Clearly print the address on the carton as follows:

To: HEATH COMPANY
Benton Harbor, Michigan

Include your name and return address on the outside of the carton. Preferably affix one or more "Fragile" or "Handle With Care" labels to the carton, or otherwise so mark with a crayon of bright color. Ship by insured parcel post or prepaid express; note that a carrier cannot be held responsible for damage in transit if, in HIS OPINION, the article is inadequately packed for shipment.

WARRANTY

Heath Company warrants that all Heathkit parts shall be free of all defects in materials and workmanship under normal use and service, and in fulfillment of such warranty Heath Company will, for a period of three months from the date of shipment, replace any part upon verification that it is defective.

The foregoing warranty shall apply only to the original buyer, and is and shall be in lieu of all other warranties, whether express or implied and of all other obligations or liabilities on the part of Heath Company and in no event shall Heath Company be liable for any anticipated profits, consequential damages, loss of time or other losses incurred by the buyer in connection with the purchase, assembly or operation of Heathkits or components thereof. No replacement shall be made of parts damaged by the buyer in the course of handling or assembling Heathkit equipment.

The foregoing warranty is completely void if corrosive solder or fluxes have been used in wiring the equipment. Heath Company will not replace or repair any equipment in which corrosive solder or fluxes have been used.

This warranty applies only to Heath equipment sold and shipped within the continental United States including APO and FPO shipments. Warranty replacements for Heathkit equipment outside the United States is on a f.o.b. factory basis. Contact the Heathkit authorized distributor in your country or write: Heath Company, International Division, Benton Harbor, Michigan, U.S.A.

HEATH COMPANY

CAPACITOR COLOR CODES

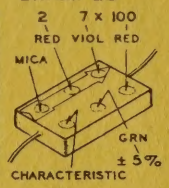
Generally, only mica and tubular ceramic capacitors, used in modern equipment, are color coded. The color codes differ somewhat among capacitor manufacturers, however the codes shown below apply to practically all of the mica and tubular ceramic capacitors that are in common use. These codes comply with EIA (Electronics Industries Association) Standards.

MICA

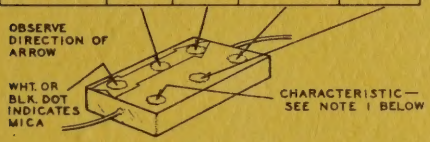
CODE

COLOR	1ST DIGIT	2ND DIGIT	MULTIPLIER	TOLER. %
BLACK	0	0	1	±20
BROWN	1	1	10	—
RED	2	2	100	± 2
ORANGE	3	3	1,000	± 3
YELLOW	4	4	10,000	—
GREEN	5	5	—	± 5
BLUE	6	6	—	—
VIOLET	7	7	—	—
GRAY	8	8	—	—
WHITE	9	9	—	—
GOLD	-	-	.1	—
SILVER	-	-	.01	± 10

EXAMPLE



2,700 μμf ±5 %
OR .0027 μfd



(VALUE IN μμf—SEE NOTE 3 BELOW)

TUBULAR CERAMIC

Place the group of rings or dots to the left and read from left to right.

CODE

COLOR	1ST DIGIT	2ND DIGIT	MULTIPLIER	TOLER. % 10 OR LESS	TOLER. % OVER 10
BLACK	0	0	1	± 20	± 20
BROWN	1	1	10	± 0.1	± 1
RED	2	2	100	—	± 2
ORANGE	3	3	1,000	—	± 2.5
YELLOW	4	4	10,000	—	—
GREEN	5	5	—	± 0.5	± 5
BLUE	6	6	—	—	—
VIOLET	7	7	—	—	—
GRAY	8	8	—	± 0.25	—
WHITE	9	9	—	± 1.0	± 10

EXAMPLE

ORG ORG BLK GRN
3 3 x 1 ±5%
33 μμf ±5%

(VALUE IN μμf—SEE NOTE 3 BELOW)

NOTES:

1. The characteristic of a mica capacitor is the temperature coefficient, drift capacitance and insulation resistance. This information is not usually needed to identify a capacitor but, if desired, it can be obtained by referring to EIA Standard, RS-153 (a Standard of Electronic Industries Association.)

2. The temperature coefficient of a capacitor is the predictable change in capacitance with temperature change and is expressed in parts per million per degree centigrade. Refer to EIA Standard, RS-198 (a Standard of Electronic Industries Association.)

3. The farad is the basic unit of capacitance, however capacitor values are generally expressed in terms of μfd (microfarad, .000001 farad) and μμf (micro-micro-farad, .000001 μfd); therefore, 1,000 μμf = .001 μfd, 1,000,000 μμf = 1μfd.

HEATH COMPANY

BENTON HARBOR, MICHIGAN

THE WORLD'S FINEST ELECTRONIC EQUIPMENT IN KIT FORM

595-506

LITHO IN U S A